EMBEDDED COPLANAR STRIPS TRAVELING-WAVE PHOTOMIXERS

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Abstract

The electric field distribution in photomixers with electrodes deposited on the surface has already been calculated[1]. It was shown that the strength of the electric field diminishes rapidly with depth. It was argued that the resulting reduction of the effective interaction volume of the device lowers the optical-to-heterodyne conversion. In this paper, we will present the results of our investigation on the influence of the electrode placement on the performance of photomixers.

We have fabricated and measured traveling-wave photomixer devices which have both embedded and surface electrodes – the nominal spacing between the electrodes was 2 μm. Devices were made using either low-temperature-grown (LTG)-GaAs or ErAs:GaAs as the photoconductive material. The dark current, photocurrent and RF emission were measured at nominally 1 THz frequency. The experimental data show a surprising difference in the behavior of ErAs:GaAs devices when the electrodes are embedded. A factor of two increase in RF radiation is observed for electric fields < 20 kV/cm. No such improvement was observed for the LTG-GaAs devices. We argue that the distinctive behavior of the two photoconductive materials is due to differences in the crystal structure – LTG-GaAs is isotropic, while ErAs:GaAs is uniaxial. We will show that the carrier mobility in-plane (parallel) to the ErAs layers in the ErAs:GaAs superlattice is larger than normal to these layers. The data indicate that carrier velocity overshoot is responsible for the excess radiation produced for the embedded electrode ErAs:GaAs devices. We conclude that engineered superlattices can outperform the traditionally used LTG-GaAs because higher carrier mobilities can be achieved without sacrificing the sub-ps carrier trapping times.

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[1]E.R. Brown, "A photoconductive model for superior GaAs THz photomixers," *Appl. Phys. Lett.* **75**, 769 (1999).